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PHYSICAL METALLURGY COLLOQUIA — VISITORS WELCOME

Distinguished metallurgists from the U. S. and abroad are featured in the spring series of physical metallurgy colloquia being held by the Department of Mining and Metallurgical Engineering on the campus in Urbana.

The entire series for the spring semester has not yet been scheduled, but two of the speakers will be Dr. M. J. Marcinkowski, Fundamental Research Laboratory, U. S. Steel Corporation, Monroeville, Pennsylvania, and Professor Paul Gordon, Department of Metallurgical Engineering, Illinois Institute of Technology, Chicago. Dr. Marcinkowski will speak on "Direct Electron Microscopic Observation of Dislocations and of Domain Boundaries in Ordered Alloys," on April 5. On April 19, Professor Gordon will speak on "Mechanism of Recrystallization."

On February 22, the speaker was Dr. L. M. Clarebrough, Division of Tribophysics, University of Melbourne, Victoria, Australia. On March 8, the speaker was Dr. V. Gerold of the Max Planck Institute, Stuttgart, Germany.

Professor Paul A. Beck, who schedules the colloquia, points out that they are held primarily for faculty and graduate students at the University, but he emphasizes that visitors from industry or other institutions are welcome. The colloquia are held at 4:00 p.m., on the dates listed, in Room 218 Ceramics Building on the Urbana campus.

As the topics, speakers, and dates of later colloquia are known, they will be published in *Engineering Outlook*.

LISTENING TO STARS

People have looked at the stars for centuries; now there are people who listen to them. These are the radio astronomers, and their "ears" are radio telescopes. These instruments hear sources of radio emission from "stars," most of which are invisible even to the most powerful optical telescope. These emitted signals or radio waves are picked up by the radio telescope's reflecting surface, bounced up to a collecting antenna that converts the energy into electric current, passed on to a sensitive receiving mechanism and finally recorded graphically by an instrument that traces the finished astronomical data on paper.

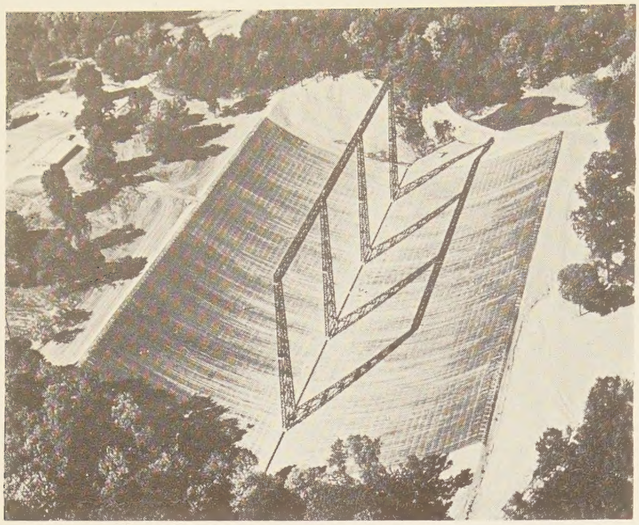
If the radio star's signal were stronger than the noise generated within the receiver of his radio telescope, the radio astronomer would be able to listen to a steady hissing noise that is similar to the hiss made by a home radio set. However, the "noise" is more often impossible to hear, being on the order of one-millionth the amplitude of the radio's hiss.

Because the radio telescope is a valuable tool in helping man to know more about the universe that surrounds him, there has been a steady increase in the number of these instruments constructed within the last few years. One such instrument is being built by the University of Illinois in a reshaped ravine five miles southeast of Danville, Illinois. The instrument is financed primarily by the Office of Naval Research with substantial contributions by the University's Research Board.

An important element of the U. of I. radio telescope, a project of the Departments of Astronomy and Electrical Engineering under the direction of Professors G. C. McVittie and G. W. Swenson, Jr., is its large parabolic reflector. This reflector, a curved "radio mirror" 600 feet long by 400 feet wide cut into the earth, is covered with a welded wire mesh laid on an asphalt and wood fiber blanket. To form the reflector, earth moving machines scooped out approximately 58,000 cubic yards of earth.

Signals from distant radio stars will be reflected from the curved trough up to 265 logarithmic-spiral receiving antennas. These antennas, specially designed for the U. of I. radio telescope by Professor John Dyson of the Electrical Engineering Antenna Research Laboratory, are unique in that they provide a simple method of scanning the antenna beam from north to south. Scanning in the east-west direction will be accomplished by the rotation of the earth; thus about one-third of the sky will be accessible to the instrument. The arrangement of the spiral antennas into an array which can be scanned in declination was designed by Dr. J. T. Lo.

The nondirectional antennas are located 155 feet above the curved earth mirror and are supported by four



Construction is nearly completed on the towers and reflector of the University of Illinois radio telescope, 5 miles southeast of Danville. The ravine has been shaped into a parabolic "radio mirror" 600 feet long and 400 feet wide. The auto just above shadow of top tower and the man standing just to the right of centerline between the two middle towers show the size of the reflector.

towers linked together by a catwalk 425 feet long, centered in the reflector. The towers and connecting catwalk are constructed of heavy wooden timbers. These timbers have been treated with a creosote preservative that gives the structure a light brown color. Interlaced with a maze of wooden braces, the towers and catwalk are held together, for the most part, with hundreds of large nonmetallic fasteners. The plastic bolts, wooden nuts, and wooden washers are used to prevent possible antenna pattern distortion.

Used in conjunction with an optical telescope, such as the giant 200-inch Palomar telescope, a radio telescope can be a celestial "finger" pointing to heretofore unrecorded heavenly bodies. Once the radio telescope pinpoints a source of radio noise, the optical telescope is aimed in that direction and photographic plates are exposed for a number of hours. In this way, mapping of the farthest reaches of space can be accomplished — and listening to the stars pays off.

MEETING OF MINDS, HUMAN AND ELECTRONIC

Can computers think? Can they learn? Are they aware of themselves? And how do they compare with man in these respects? There are probably as many different opinions as there are people to think up these questions. They are actually questions which can not be answered at present, not because we do not know enough about the computers, but because we do not know enough about ourselves. The problem is one of logic and semantics. We can not define "thinking," "self-awareness," "intelligence," or "learning" — and it is meaningless to try to compare men and computers if we do not agree on the meanings of these terms. But it is interesting to note that the more fully any of these attributes can be described, the better a computer can be made to simulate them.

The biggest single difference between men and computers is that men do not have to be precise and computers do. Man's lack of precision is responsible for many of his successes and many of his failures, while the computer's extreme precision accounts, for example, for its abilities in rapid computation and its shortcomings in versatility. Man is a jack-of-all-trades and the computer is a narrow specialist.

But by most definitions computers do think and do have intelligence. Most people in the computer field agree on this and do not bother themselves with such questions; they are much more interested in: "How can we make the sort of thinking the computer can do more beneficial to man?" This is the basic question behind all the activities of the University's Digital Computer Laboratory, an interdisciplinary research facility under the U. of I. Graduate College.

The Laboratory and its equipment are available for use by all groups or departments on campus. In addition to this service function, the Laboratory personnel engage actively in computer research, and there is a graduate training program associated with every research program. These programs number six at present: computer design and construction, computer circuits, switching theory, automatic analysis of extensive data, numerical analysis, and studies on efficient methods of using computers.

The Computer Laboratory has two large computers at the present time and will soon have a third. The two pieces of existing equipment are an IBM 650 with magnetic tape units and the ILLIAC, a general purpose computer which was designed and built by University personnel in 1952. The IBM machine provides computing facilities for punched card data and is used both for University administration work and research problems. The ILLIAC is a binary type digital computer, using numbers consisting of a sign and 39 binary places with the fixed point following the sign. In other words, one might say that ILLIAC only knows two digits: zero and one!

ILLIAC has two memories, one providing random access to any of 1,024 words of binary digits, and the other having a capacity of 12,800 words. Input to the machine is normally by standard five-hole paper tape, and output may be obtained by the same type of tape. A data plotter also provides a visual display of results. A library of machine routines has been prepared which facilitates efficient use of the computer on many scientific problems. With this system many complicated problems can be solved without extensive additional programming. ILLIAC is in use substantially 24 hours a day. Its major users include the various departments of the College of Engineering.

For the last three years the Laboratory personnel have been designing and constructing ILLIAC II, an ultra high-speed computer 100 to 200 times faster than ILLIAC. The comparative speeds for less complex functions are shown by this table:

	ILLIAC	ILLIAC II
Addition	92 microseconds	1.5 to 2.5 microseconds
Multiplication	700 ”	5 to 7 ”
Division	965 ”	15 to 20 ”

In other words, ILLIAC II could multiply two 52 digit numbers together and give an answer within five millionths of a second!

ILLIAC II will also have two memories, the capacities being 8,192 words in the main unit and 65,536 words in the auxiliary. Input and output facilities will include punched cards, punched paper tape, and magnetic tape.

The personnel of the Digital Computer Laboratory all hold joint appointments with other departments, either Mathematics, Electrical Engineering, or Physics. Although there is no degree awarded in digital computer work, students in Math, EE, or Physics may write theses with staff members of the Laboratory.

The Computer Laboratory personnel point out that both the man and the machine do the job for which they are best fitted: the computers take over many time-consuming computational tasks, freeing man's mind for the more creative thinking the computer can not do. The Laboratory personnel themselves feel the obligation to do whatever they can to help keep and improve the harmony and efficiency of this man-machine partnership.

PREDICTING THE BOUNCE PER OUNCE

Anyone who has seen railroad rails move up and down when train wheels pass over them can appreciate the problems in designing a free-flight rocket launcher. The design has to be a compromise between the unwanted flexibility inherent in lightweight mobile launchers and the desirable rigidity which accompanies a massive system. Some aspects of this problem have been resolved by a research group under Professor Marvin Stippes of the Department of Theoretical and Applied Mechanics. The project has been sponsored by the Rock Island Arsenal of the Army Ordnance Corps since 1957.

Because of the lightweight characteristics of a mobile launcher, the moving mass of the rocket causes a deflection in the launcher rails, a movement which can have significant effect on the rocket's flight path. Some of the problems have been to learn how much deflection and pitch velocity were being imparted to the missile at the end of guidance, and how much variation there is from launcher to launcher or from missile to missile. These rockets are tactical weapons which require single-

An Honest John rocket being fired from a mobile launcher of a sort being studied by the University of Illinois group.

shot pinpoint accuracy, and achieving it is equivalent to hitting the bull's-eye with a bullet fired from a flexible-barreled rifle not held in a fixed position.

During this study a number of analytical design factors have been computed and passed on to the appropriate agencies. Equations of motion have been worked out, and much information has been accumulated relating pitch velocity to the various geometrical and material parameters of the launcher system. Surprisingly enough, a launcher does not need to be designed to satisfy the static requirements of stability. A launcher system may be completely unstable with the missile placed at the end of the beam, but completely stable under firing conditions. The investigators have established bounds on the size and flexibility of the system to satisfy the requirements of dynamic stability. If one knows how flexible his rifle is and how much it deflects, he can still put a bullet in the target. If he also knows the limits of variation between various rifles and bullets, he can score a high percentage of hits out of a large number of firings. Application of the results of this fundamental research has enabled the sponsoring agency to improve the accuracy and at the same time reduce the weight of important equipment by as much as 30 per cent.

PARTICIPATION IN ROOFING STUDIES

An interesting construction feature of a modern community is the large acreage of flat built-up roofing used on such buildings as shopping centers and schools. These roofs offer economy and ease of construction for large buildings, and they are often the only possible choice from the standpoint of appearance.

But in spite of their advantages, these flat surfaces take a beating from the weather. Solar intensity, rain, frost, ice, cyclical thermal expansion, and moisture penetration from below have resulted in many roof failures. Some of these failures involve thousands of dollars in damage and resulting law suits. In late 1959, the National Roofing Contractors Association turned to the University's Small Homes Council – Building Research Council for help with this urgent problem.

The two-year investigation, under the direction of Professor Donald E. Brotherson of the Department of Architecture, consists of literature surveys, field surveys of roof failures, and laboratory studies. Findings to date suggest that the roofing problem could be one of moisture transport from below, complicated by cyclical heat flow of unusually large magnitude. Professor J. R. Carroll of the Mechanical Engineering Department is serving as an engineering member of the seven-man Advisory Committee for the project.

BEHAVIOR OF MATERIALS SEMINAR

Mr. George J. Verbeck, manager of the Applied Research Section of the Portland Cement Association, is giving a series of lectures this semester for a Theoretical and Applied Mechanics seminar on the Physical Chemistry of the Behavior of Materials. The lectures, to be held in 302f Talbot Laboratory, are scheduled for 2:00 P. M. on approximately every other Monday. The next lecture is scheduled for Monday, March 27th.

Anyone interested in the physical chemistry of cement, concrete, ceramics, polymers, glasses, metals, and wood is welcome to attend. For further information about scheduling or lecture content, contact Professor Clyde E. Kesler, 103 Talbot Laboratory, University of Illinois, Urbana.

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